

# NEW COATINGS AND PLASTICS FROM STARCH AND SUGARS

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Most of the starch produced in this country from various sources (corn, potato, sweet potato, wheat, etc.) or normally imported is used for food. The most important industrial uses of starch are for finishing wearing apparel and household fabrics in laundries, for sizing paper and textiles, and for making adhesives. Mild treatment of starch with heat or with heat in the presence of certain chemicals modifies its composition and properties, and the resulting dextrans, thin-boiling starches, oxidized starches, etc., are suitable for food, adhesives, and sizing materials, and for various other purposes. By more drastic treatment with heat and acid, starch sirup and crystalline dextrose can be prepared.

Chemically speaking, starch is an alcohol and is capable of all reactions characteristic of the alcohol group. By these chemical reactions, new compounds—starch derivatives—are produced, which have lost most of the properties of starch and acquired new physical and chemical characteristics. Of the numerous derivatives prepared thus far, only one—starch nitrate—has found practical use. This is used as an explosive.

Work carried out at the Eastern Regional Research Laboratory has revealed that the allyl ether of starch (allyl starch) possesses properties which promise to make it suitable for many purposes. Allyl starch is prepared by the action of allyl chloride (made from a byproduct of the petroleum industry) on starch. The process is described in detail in an article published in *Industrial and Engineering Chemistry* (February, 1945). As prepared by this method, allyl starch is a gummy but not sticky substance. It dissolves readily in a number of organic solvents, such as alcohol, acetone, chloroform, benzene, and toluene. When the solution is applied to the surface of a smooth, porous or fibrous material, such as wood, metal, and paper, and the solvent is evaporated, a smooth glossy coating remains. When the allyl starch coating is heated for a relatively short time (1 to 4 hours) at 175 to 210 degrees Fahrenheit, it becomes resistant to all known solvents, hot oils, and reasonably concentrated acids and alkalies, and withstands temperatures up to 400 degrees Fahrenheit. Alcohol, gasoline, and other liquids could be spilled on a table top coated with allyl starch with-

out leaving spots or in any way injuring the surface, and hot dishes would not leave marks. The process for making allyl starch resistant to heat and various reagents can be accelerated by various means; for example, by addition of paint dryers (cobalt naphthenate, etc.) or by the use of infrared or ultraviolet radiation.

A solution of allyl starch can be used for impregnating wood, paper, and textiles, making these materials more resistant to wear and various reagents. It may also be used as an intermediate for plastics. The gummy allyl starch can be modified by mixing it with substances commonly used for vulcanizing rubber, such as sulfur and vulcanization accelerators. Heating such mixtures in a mold under pressure produces a rigid material which is highly resistant to heat and chemical reagents. Allyl starch possesses good adhesive qualities, and laminated products of good strength and quality can be prepared from wood veneer, paper or fabrics by coating the sheets with this material and subjecting them to heat and pressure.

A number of interesting and potentially useful derivatives of other carbohydrates have been prepared. For example, allyl sucrose has been made from ordinary sugar. It is a heavy liquid which by heating in the presence of oxygen can be made into a clear transparent plastic material. Coatings of allyl sucrose are hard and glossy, resembling enamel more than lacquer or varnish. Similar materials can be prepared from dextrose, mannitol, sorbitol, methyl glucoside, and many other polyhydroxy compounds. The preparation and properties of these derivatives are described in two articles published in the *Journal of the American Chemical Society* (October, 1944 and January, 1945). All behave approximately the same as allyl starch or allyl sucrose. Coatings of various degrees of hardness, adhesiveness, or penetrating power, and solvent- and heat-resistant plastics can be made from them. They are easily miscible with each other, permitting modification of their properties.

The production of coatings from allyl derivatives of starch and other carbohydrates represents a potential industrial outlet for starch and sugar crops.

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## CHEMURGIC PERSONALITIES



**Jesse Clyde Nichols**

J. C. Nichols, realtor, city planner, civic leader, and developer of one of the world's finest residential sections, started life as a farm boy, son of pioneers of Johnson County, Kansas. He graduated from Olathe High School, then worked his way through Kansas University, winning a scholarship which took him to Harvard. At Kansas University he was awarded membership in the Phi Beta Kappa, and also in the honorary fraternity Beta Gamma Sigma, being the first man ever elected to this latter organization from his school.

While in Harvard, Nichols became interested in the use of land. After graduation, he went to Kansas City, Kansas, where, with capital borrowed from his farmer friends, he built a group of small houses. Later he moved to the southwest section of Kansas City, Missouri, and bought a ten-acre tract and started the Country Club District now comprising some four thousand acres; ten shopping centers; four eighteen hole golf courses; fifteen churches; nineteen public and private schools; many playgrounds, and housing some 50,000

people. This district is famous throughout the world and has been used as a model many times.

Mr. Nichols has supported every good movement ever initiated in his home town and state. He served as a member of the Board of Education for eight years. He led the movement for improvement of the Missouri River to reduce freight rates, and served for years as president of the Kansas City Art Institute. He is a trustee of the Kansas City Conservatory of Music, of the Philharmonic Orchestra Association; has been director of American Civic and Planning Association for many years, and is now serving as chairman of a Community Builders Council to promote better community development throughout America.

Mr. Nichols is very proud of four certificates of appointment bearing the names of four different United States presidents, which hang upon the walls of his office, and evidence nineteen years service on the planning commission of Washington, D. C.

Early in 1940 Nichols went to Washington to serve as a dollar-a-year man under General Knudsen and spent some fifteen months in the defense program. Later he spent about six months in Washington as adviser to the Public Buildings Administration. He also served for six years as a member of the Business Advisory Council for the Department of Commerce of the United States.

Further, he firmly believes that it is only through a balanced economy in all parts of the country that America could grow and prosper and win the war. Today he is fighting with all his strength for continued industrial growth. For many years he has been an advocate of industrial use of agricultural products. To this end while in Washington he made a careful study of all research institutions in the east, and became convinced that a great research institute to serve all the middle west was the answer. So, he began a quiet campaign involving many months of education of the business men of his city; months during which he insistently talked research. Finally, a fund of \$500,000 (outright gifts) was raised and thus the Midwest Research Institute was born in Kansas City to serve the whole middle west. This institution is working in close collaboration with all the leading educational institutions of the area and bids fair to become one of the great industrial research institutions of the country.

When asked about his hobbies Mr. Nichols laughingly remarked that he guessed his six grandchildren were as fine a hobby as a man could have, and that the greatest pleasure he had was the time he was able to spend with them. However, as a matter of fact, he waxed enthusiastic about a small farm place which he built several years ago upon the roughest piece of ground he could find near Kansas City. The house itself is built along ranch type architecture and furnished entirely with things purchased in Mexico and Spain.

Mr. Nichols is an inspiring speaker, and has made many speeches all over the United States, and written numerous pamphlets on such subjects as city planning, neighborhood planning, river transportation, shopping centers, residential property, zoning, regional planning, art in industry, foreign trade possibilities, stabilization of urban value, the building of a great art collection, and possibilities of research to balance industry in the middle west and thus build a greater America.

# BREEDING CROP PLANTS FOR INDUSTRIAL UTILIZATION

By MURRAY L. KINMAN

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Industrial application of advances in chemical technology has opened a new field in agricultural research. This new field is a branch of agronomy and may be called breeding crop plants for industrial utilization.

In the past the plant breeder has in most instances attacked the problem of developing new varieties of crop plants almost entirely from the standpoint of increased yields to farmers. Such an approach was probably justified in the early years of scientific crop breeding and while the needs of the industries using farm products were less highly specialized. As more and more of the produce of our farms pours into industrial channels it becomes increasingly apparent that such an approach is no longer adequate. The plant breeder must not only develop varieties that meet the needs of the farmer but must also consider the needs of the industrialist.

It is only within the present decade that this type of research has attracted much public attention. The Bankhead-Jones Act passed by Congress in June, 1935, stated as one of its purposes,

"The Secretary of Agriculture is authorized and directed to conduct research relating to the improvement of the quality of, and development of new and improved methods of production of, distribution of, and new and extended uses and markets for, agricultural commodities and byproducts and manufactures thereof."

This act led to the establishment of the various regional laboratories within the United States Department of Agriculture. While the work of these laboratories has been excellent in finding new uses for farm products and in some cases of breeding superior crops for these uses and some state agricultural experiment stations have followed the example thus established, in general, sufficient funds for this type of research have not been available. Even in some cases where personnel and physical facilities are available, a lack of appreciation for the need of cooperation between industrialists and chemists and the men actively engaged in crop improvement has prevented the most rapid progress along these lines. Of course, a great many of the new synthetic products using farm crops as raw material have been and will be developed directly by the industries concerned in their manufacture. Research directed both toward development of new crops adapted to this region for specific industrial uses and toward establishing new chemurgic uses for farm products are two of the primary aims of the Institute of Technology and Plant Industry of Southern Methodist University. We will attack new problems in these fields as they are presented to us and as physical facilities for this work become available.

The development of new synthetic products derived from farm commodities must be accompanied by the production of new varieties of farm crops and even new crops, the chemical and physical composition of which meet the needs of the specific industrial processes for which they are intended. Fortunately, within

each species of plants wide variations in amount and type of the various carbohydrates, fats, and proteins present in the tissues seem to exist. This is apparently also true of vitamins, minerals, waxes, and other compounds which are also included in the chemical makeup of the roots, stems, leaves, and seeds of plants. With the aid of the biochemist the plant breeder can develop varieties high or low in specific compounds. In this he is, of course, limited by the amount of genetic variability which exists in the plants with which he works, by his ability to combine these characteristics with others which make it possible to produce the crop economically, and by the chemist's ability to determine accurately the composition of the samples submitted to him. Advances in the last factor are constantly being made.

An excellent example of crop breeding with a specific industrial use in mind, and incidentally also of significance to the war effort, is reaching its successful conclusion. When Japan took the Netherlands East Indies, we not only lost our main supply of rubber and tin but also our tapioca starch, which is obtained from the root of the tropical cassava plant. Most of us could get along without tapioca pudding for the duration. Unfortunately, most of the tapioca starch was not used for pudding—it was used in the manufacture of gums, mucilages, adhesives, wood glues, and for cloth and paper sizings. Many of these uses are essential to our peacetime economy and doubly so in time of war. We imported 350 million pounds of this starch annually. Last fall (1944) about 16,000 acres of waxy corn, which furnishes a substitute for tapioca starch, were harvested in the Corn Belt. Together with about 22,000 acres of waxy sorghum grown in Texas and Kansas, this will make up about one-seventh of the shortage. If the demand is great enough, the entire deficit can be made up in another year or two.

The waxy character has been used in theoretical genetic studies with corn since its discovery in 1908 by a missionary in China. Genetically the difference between ordinary nonwaxy corn and waxy corn is due to a single factor—the waxy being recessive to the dominant nonwaxy condition. It was not until about 1936 that the similarity between waxy cornstarch and tapioca starch was recognized. In 1939 a program to breed the waxy character into a high yielding corn hybrid was begun. This was accomplished by the fairly simple breeding technique of crossing the waxy stock with established inbred lines of corn and backcrossing generations to the established lines with continuous selection to retain the waxy character. The development phase of this research program may now be considered completed, since a waxy corn hybrid acceptable to both farmers and starch manufacturers is now available.

The only difference of interest between ordinary and waxy corn is in the type of starch stored in the seed. While the waxy seed appears somewhat more opaque and starchy than ordinary corn, the only safe way to

distinguish between the two types is by staining with an iodine solution. Ordinary cornstarch stains blue with iodine solution, whereas waxy cornstarch stains a reddish brown. Physically the two types of starch differ in that after being properly mixed with water and heated, the ordinary or nonwaxy starch possesses high gelling properties and relatively low viscosity, while pure waxy cornstarch with extremely high viscosity has almost no tendency to gel. Most starches consist of a mixture of two types of molecules; the straight chain molecules, which make up the "amylose" fraction of starch and are responsible for its blue color with iodine, and branched chain molecules, which make up the "amylopectin" fraction and give only a red or reddish-brown iodine color. Ordinary cornstarch contains about 22 percent of the blue staining constituent, or amylose, while waxy starch contains none at all, being 100 percent amylopectin. Waxy cornstarch is physically and chemically well suited to replace tapioca starch in most of its important uses. Even after the war it may be able to compete on a quality basis with the cheaper foreign starch.

Credit for the development of high yielding waxy corn hybrids is due principally to two plant breeders employed by the United States Department of Agriculture, Dr. Merle T. Jenkins, Principal Agronomist in Charge of Corn Investigations, and Dr. G. F. Sprague, Senior Agronomist, who is stationed at Iowa State College. Dr. R. M. Hixon, head of the Plant Chemistry Subsection of Iowa State College, and his associates were responsible for the chemical research necessary for establishing the fact that starch from waxy corn can be substituted for tapioca starch. The American Maize Corporation, which furnished much of the incentive and some funds for this work, contracted with farmers for the actual growing of the crop, guaranteeing a substantial premium over the price received for ordinary corn. They extract the starch by the wet milling process.

Development of waxy sorghum varieties proceeded in a similar manner, credit being due various research workers of the staffs of the Texas and Kansas agricultural experiment stations for their part in this work.

This example of a plant breeding program designed to produce a new type of corn for a special industrial use has shown what can be done in a relatively short time with a knowledge of a few facts and principles and with proper cooperation between science and industry. Fortunate indeed for the quick solution of the waxy starch problem was the fact that it has the simplest possible genetic basis. Most of the problems in breeding crop plants for specific characters of value to industry have a much more complex genetic basis, and progress will necessarily be slow as we feel our way forward developing new techniques and profiting by our past experience and errors as we proceed.

Let us mention a few of the interesting possibilities in breeding some of our more common farm crops for specific uses. In the dry milling of corn, certain characteristics of size and shape of the corn kernel are highly desirable, and higher oil content would give added profits from this important byproduct. Indications are that considerable improvement can be made in both of these characteristics. This is one of the research problems with which the plant breeding program of the Institute is actively engaged. Corn also offers interesting

possibilities for improving both the quantity and quality of the protein fraction of the grain. This may be of value in improving both human and livestock nutrition.

Most of you are familiar with the rapid strides made in the use of soybean products in the plastic and paint industries and in the production of edible oil and protein foods. Up to this time, no varieties of soybeans that can consistently produce satisfactory yields of oil and protein have been found for this section (South-west). If such varieties can be found or developed, they should fit into our economy very nicely. We already have cotton oil mills and refineries to handle the processing, and markets are already established for the oil and for the high quality protein feed produced from this crop. In our soybean breeding project we have some indications that varieties suited to our particular climatic conditions may in time be developed.

Rapid expansion in production of grain sorghums in the drier areas, especially since the advent of types suited for harvesting by the combine, has provided an additional source of carbohydrates for industrial utilization. More research is needed in the commercial processing of this crop before its full potentialities as a source of industrial alcohol and other chemicals can be realized.

There is an open field for breeding grass and legume crops in vitamins and other nutrients for use by dehydrating plants. A much longer list of the promising leads for breeding crops for special uses could be presented for use by dehydrating plants.

In developing new varieties of crop plants for specific industrial uses, the need for cooperation between industrial processors and research workers cannot be overemphasized. Often the processor will be the first to point out the need for changes in the existing raw materials. After the plant breeder and chemist working together determine what changes are possible, the chemist may be called upon to develop new techniques of analyzing samples in order to tell the plant breeder whether he is progressing in the right direction on his specific problem. A real evaluation of the merits of one of these new specialty crops can be made only after pilot tests on a commercial scale have been undertaken by the processor.

When new crops and new finished products become available, benefits may be widespread. Farmers who grow these specialized crops will be benefited, the manufacturer may have a new or improved product or an extra source of revenue from byproducts, and consumers may receive a new or higher quality finished product at considerable saving.

Summarizing briefly, let me say, that if the plant breeder is given the cooperation of chemistry and industry, he can, with the proper facilities and sufficient time in which to develop the full potentialities of the crops with which he works, alter them in such a manner that they will yield the maximum quantities of the right kinds of natural raw materials, which are the basis for our expanding chemurgic industries.

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*A new "de-barker" is being used in some pulp mills that removes the bark from logs by the force of a jet of water at 650 pounds pressure without removing any wood. The saving in wood is said to be as high as 20 percent.—American Machinist.*

## New Members

The following is a list of recent applicants for associate membership in the National Farm Chemurgic Council, and who have been approved and accepted by the membership committee.

### Alabama

Riemers Farms, Elberta

### California

Leo Carrillo, Santa Monica

Ira D. Guthrie, Watsonville

Mrs. Charles E. Millikan, Glendale

Rheem Manufacturing Company, San Francisco

### Connecticut

Roger M. Charbin, Norwich

### Florida

Marion G. Denton, Auburndale

### Georgia

Emory L. Cocke, Atlanta

Miss Modane Marchbanks, Atlanta

### Illinois

Aetna Plywood and Veneer, Chicago

M. R. Finley, Hoopeston

J. David Larson, Hinsdale

Ballard Moore, Chicago

### Indiana

Harry E. Vernon, Goshen

### Massachusetts

New England By-Products Corporation, Boston

### Michigan

J. W. O'Meara, Detroit

C. Lew Taylor, Saginaw

### Missouri

Peter W. Salsich, St. Louis

### Montana

Miss Dorothy Schoknecht, Kalispell

### New Jersey

Miller W. Swaney, Elizabeth

### New York

John B. Calkin, New York

Dr. V. Froelicher, New York

### Ohio

James W. Fravel, Mt. Vernon

Jacob Graber, Hartville

Darrell S. Jones, Newark

Dana H. Perkins, Westlake

Miss Eleanor Reynolds, Novelty

Willis R. Rupert, New Waterford

J. E. Van Fossen, Croton

### Oklahoma

Fred Goff, Edmond

Mrs. Oscar Monrad, Oklahoma City

### Oregon

Ivan Bloch, Portland

W. Brooks Casebeer, Portland

Farm Market Relations, Inc., Portland

Elwain H. Greenwood, Portland

Frederick M. Hunter, Eugene

Burton Hutton, Portland

The Rev. Joseph McGrath, Portland

Elmer McClure, Milwaukee

Oregon Nut Growers, Inc., Newberg

Percy M. Robinson, Albany

Arthur F. Scott, Portland  
Henry Semon, Klamath Falls  
H. C. Seymour, Corvallis  
Silverton Flax Company, Silverton  
Charles W. Smith, Corvallis

### Pennsylvania

Richard Conyne, Philadelphia

Raymond T. Parkhurst, Bangor

E. R. Ross, Bedford

### South Carolina

Alfred Scarborough, Sumter

### Tennessee

Albert H. Musick, Memphis

Ruhm Phosphate and Chemical Company, Mt. Pleasant

### Texas

Beaumont Chamber of Commerce, Beaumont

William O. Harwell, Denison

### Washington

Longview Development Council, Longview

### Wisconsin

Fond du Lac Association of Commerce, Fond du Lac

### Canada

W. F. Barrington, London, Ontario

British Columbia Electric Railway Company, Vancouver, British Columbia

Canada Glazed Papers, Ltd., Toronto, Ontario

Chipman Chemicals, Ltd., Winnipeg, Manitoba

Department of Agriculture, Quebec

Dr. Hope, Saskatoon, Saskatchewan

Erle Kitchen, Toronto, Ontario

Norman G. McCully, St. Marys, Ontario

Jean-Paul Page, Quebec

## PENICILLIN PROMISING IN MASTITIS

A promising new use for the remarkable drug, penicillin, is the treatment of chronic bovine mastitis, one of the most injurious diseases of dairy cows. In preliminary experiments conducted recently by scientists of the United States Department of Agriculture, small quantities of a culture filtrate of the *Penicillium* mold grown on corn steep liquor, gave promising results. This material, which was of relatively low and variable penicillin content, was used, since a refined product was not available for the work. Nevertheless, when infused into affected quarters of 59 cows, the culture filtrate eliminated from 48 to 60 percent of the infective organisms. These included *Streptococcus agalactiae*, the principal species of bacteria causing mastitis, and also various staphylococci which complicate the condition.

Though emphasizing that results thus far are inconclusive, the scientists consider them on the whole, favorable enough to warrant further tests with purer penicillin.

## SUCCESS FOR SILK

Although past attempts to make a financial success of the silk industry in California have failed because of inability to meet the competition of cheap labor in Japan, an interim committee of the California legislature now reports that a new mulberry leaf picking machine and a reeling machine will reduce production costs sufficiently to meet Japanese costs. California can produce three crops a year to Japan's one.—*Western Industry*.

## CORK GROWING IN LOUISIANA

By RALPH W. HAYES, *Head*  
*Forestry Department*  
*Louisiana State University*

Neither a nation, a country, nor an individual should be an isolationist, but self-sufficiency in an emergency is as important for a nation or a country as for an individual. Commerce and trade are the life of the world, but war curtails normal activity and often produces shortages of materials which are acute. This has been true in this war with cork. In normal times most of our cork is imported from the Mediterranean area.

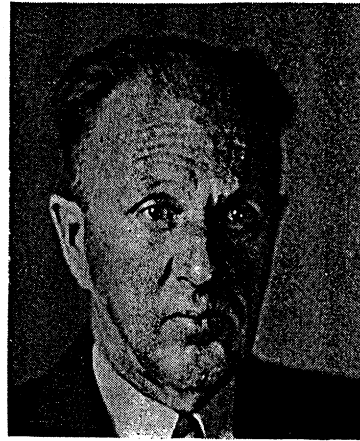
Forward looking citizens of our country believe that we can produce at least our minimum requirements of cork in our own country. Louisiana is within the area where cork trees grow well. Cork oak trees planted in our State, and other states where they will grow, will, we believe, go a long way toward eventually producing our national requirements. At the same time it introduces a new source of income for the landowner.

Cork oak trees need not be planted in large groups. Five, ten, fifty or more trees can be set out on parts of the farm where the soil does not produce good crops, or where shade is needed. They do not require care or cultivation after the first two or three years, and they will grow, provide shade, and in ten to twenty years produce a bark thick enough to "strip."

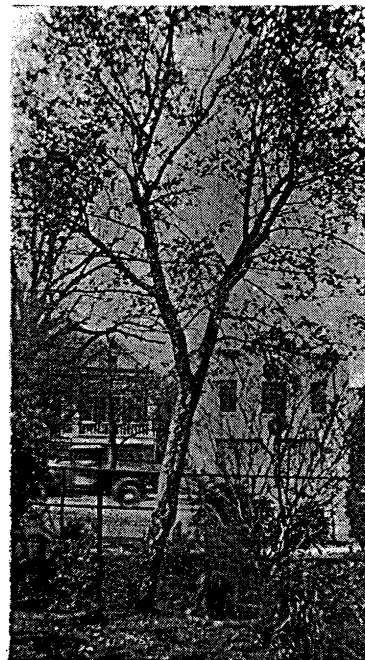
The exercises on the State Capitol grounds, Baton Rouge, Louisiana, on January 26, as an Arbor Day celebration, was for the purpose of bringing the cork oak and its possibilities to the attention of the people of the State. Mr. Charles E. McManus, president of the Crown Cork and Seal Company, is sponsoring a national cork growing campaign. Acorns have been imported from Spain, and many have been collected from trees now growing in the United States. These acorns have been distributed and grown in nurseries for distribution to people who desire them. The State Forest Nursery at Woodworth, Louisiana, produced about 15,000 of these cork oak seedlings last season. They will be distributed to persons requesting them as long as they last.

There is no authentic record of the actual number of cork oak trees now growing in Louisiana. There are probably several which have been planted in different parts of the State on which no record has been kept. We do know that there are six cork oak trees twelve years old growing in Shreveport. These trees are healthy, thrifty, and are now developing a heavy cover of bark. We do not have an actual record of the way in which these trees were planted but probably acorns were brought to this country and given by travelers to friends who wanted to plant them. The acorns were probably planted where the trees were desired, and the trees grew with little or no attention. Better results will come with seedling production in nurseries, and planting of seedlings.

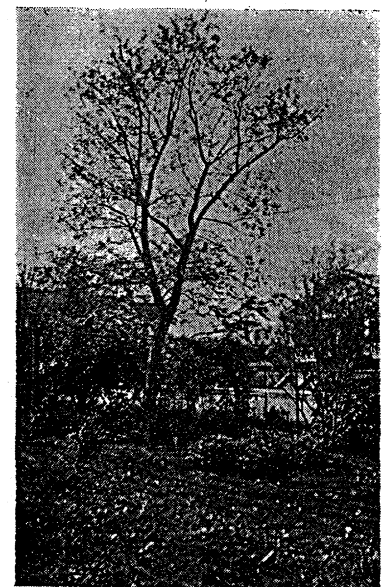
We believe this cork oak has fine possibilities in Louisiana. Very few people will make large plantings, but many will plant a few trees. Beauty and shade will be provided, and when the trees get large there will be a periodic income, not large from any one or five trees but enough to help out on Christmas shopping, or for some special family need or desire. We believe the time will come when Louisiana will be a recognized producer of "Cork."



Ralph W. Hayes



Cork Oak Tree  
Growing in  
Louisiana.



Cork Oak Tree  
Shreveport,  
Louisiana.

# THE CHEMURGY OF COTTON

By JOHN LEAHY, *Director*

*Cotton Research Committee of Texas  
College Station, Texas*

Farm Chemurgy, as a forward looking and dynamic entity anticipates applying technology, i.e., working with and for chemical compounds which occur out of vegetative growths, and constitute the constantly recurring beneficences of nature in contrast to chemical compounds extracted from natural warehouses where from the dark reaches of our cosmic evolution nature has stored its energy and its bounty for multi-millions of years just as the lower order of animals store up energy in the form of fat for a long hibernation.

For one hundred and fifty years, or since the dawn of the Industrial Revolution, our industrial civilization has lived off the fat of nature in its consumption of coal, iron, petroleum and the products of forests; all of which represent thousands and millions of years of accumulated natural effort. To produce such raw materials or crude products as a human endeavor in keeping with our current consumption would entail prohibitive costs and would be practically impossible of achievement in respect to volume even if we had the technical capacity or the technical means to synthesize those exact compounds or aggregate the elements.

It is a function then of chemurgic enterprise generally and farm chemurgic activity specifically to develop alternative raw materials or crude products capable of displacing those natural accumulations of matter to the end that our civilization may function out of its current resources in lieu of living off its fat or out of its capital.

Cotton wholly epitomizes such aims, purposes, and functions of the chemurgic concept. It produces food, feed and fiber only after a technological operation because the boll of cotton as an entity is neither food, feed nor usable fiber. Moreover, it is apropos to reiterate that it is a function of chemurgic enterprise to work with and for chemical compounds to serve the purposes and needs of civilization. From the beginning of time nature provided the where-with-all to sustain life and out of the intellect of man a method of living was evolved to make life worth living which we term civilization.

In any stable realization of the chemurgic concept we must start from scratch; our effort is undertaken from a bench mark, a stable point of origin. Insofar as we are interested in making chemurgic undertakings work out practically, we are compelled to make cotton research activity the bench mark for projecting the chemurgic future of Texas.

In working with and for chemical compounds, we are compelled to consider from what sources they are obtainable. It isn't enough to say that they abound, because they must be economically available to be usable at all. Chemical compounds occur in the earth as minerals, in plants, within the oceans and the atmosphere. To mine the earth or the oceans for chemical compounds or to synthesize them from the atmosphere is admittedly a technical achievement of a high order; however, in evaluating such achievements for the long pull we must conclude that they are but stop gap measures which lend momentary impetus to our developing civilization. By way of example, a ten year holiday in

cotton production would pose a problem in reforestation that would make the present wood supply situation appear to be one of lush abundance. An augmented production of nylon to meet all fiber needs would seriously impair the security of our position with respect to coal.

Conversely, we have within our capacity a cotton production potential which we are not realizing on event to the extent of 50 percent. A production potential which possesses every significant chemurgic attribute. It is by virtue of just such situation that I say that cotton epitomizes the aims, purposes and functions of the chemurgic concept. It entails the working with and for chemical compounds synthesized by nature through the medium of plant or vegetative growths.

Viewing cotton wholly in respect to its functional merit as an instrument of nature for synthesizing a wide variety and multiplicity of chemical compounds as well as its agronomic adaptability we are compelled, on its intrinsic merit, to lay claim for what it is—the world's foremost chemurgic crop.

From a utilitarian standpoint cotton fiber has no peer. In the form of cotton linters nature gives us through the medium of the cotton plant its purest manifestation of alpha cellulose. Cottonseed is the premium oil of domestic production. Cottonseed meal is in support of the animal industry of the nation and in such deficient supply as to support a premium price over anything we can immediately hope to achieve through an industrial application for its protein. The cottonseed hull is the raw material source for furfural which is the pace making technical chemical compound of chemurgic distinction. These present products of utility from the cotton plant yield in excess of one billion dollars of agricultural wealth and less than one percent of that gross annual, constantly recurring wealth comes from the soil as an expenditure of our agronomic capital. Approximately 99 percent of the wealth of cotton comes out of the air.

The foregoing represent the present raw products of the cotton plant but the capacity of the plant as a chemical laboratory of nature is even more extensive which may be illustrated by the findings of the Georgia Experiment Station and published in their Bulletin No. 222. The experiment discloses a yield of 538 pounds of nutrients or elements of fertility which are chemical compounds within the chemurgic sense, from a total dry weight yield of 9720 pounds. This yield was obtained from an application of only 108 pounds of fertilizer elements. The seed of fertility is planted with the seed of cotton to produce a five-fold yield of fertilizer elements in a readily available form. The case is presented here simply to illustrate the fact that the cotton plant has many natural function which are as yet unexploited.

To fully develop the chemurgic opportunities for cotton will necessarily impose a need for greater production. Superficially this may appear as a contradiction of what many persons choose to call the plain facts of cotton. The attitude is based upon the notion that cotton means only one thing and that one thing is spin-

nable fiber. Therefore, when I refer to the chemurgic potential of cotton I am not thinking exclusively in terms of spinning utility. The spinnable grades of cotton fiber are not in excess supply; nonspinnable cotton is priced out of the cellulose market but is moving into consumption in expanding volume as thermal insulation. The war vital commodities which depend upon cotton as their source are in deficient supply, specifically cottonseed oil, cottonseed meal, cottonseed hulls and linters.

Like Alice in Wonderland, many people crawl through the mirror to examine not the cotton situation, but its reflection. Beyond the mirror what should be right handed appears to be left handed. A typical left handed handling of the cotton situation is illustrated in the matter of parity price. In the field of politico economics the farmer is entitled to a parity income. A parity price may be maintained and supported in the operation of sound economic processes by reducing production which gives the grower less to sell at his parity price and less cold cash income. It is conceivable that a considerably increased volume of cotton can yield a parity income without having to sell at a parity unit price. We anticipate lowering cotton production costs by mechanization which should operate to improve the income position of the grower through his greater man hour production capacity. His greater man hour production capacity will yield him leisure rather than income if his progressive attitude in adapting and employing methods technology to his farm production practice is not made practicable by providing a market fee of any kind of an artificial restraint.

For cotton to experience a vital chemurgic future we must deal directly with cotton and not with a reflection in the mirror of Alice.

#### PUBLICATIONS AVAILABLE

The following publications have just been received from the Union of South Africa. They are available on a loan basis of two weeks to any of the members of the National Farm Chemurgic Council who wish to compare agricultural methods in South Africa to those of this country. Order them by the number listed below.

No. 1. Observations on the distribution and rate of growth of Clanwilliam Cedar *Widdringtonia Juniperoides* Endl.

No. 2. The effects of soil and climate on the growth and vigour of *P. Radiata* D. Don in South Africa.

No. 3. Historical sketch of the development of forestry in South Africa.

No. 4. The rate of growth and health of the southern pines in the Midland Conservancy.

No. 5. The place of wattle bark in the leather trade.

No. 6. The influence of age on summerwood ratio in pine timber. A quantitative consideration of apical incidence.

No. 7. The growing of *Populus deltoides* in South Africa.

No. 8. South African grown furniture woods.

No. 9. The raising of transplants of indigenous tree species for open-rooted planting.

No. 10. The utilization of South African grown *Eucalyptus saligna*.

No. 11. Rainfall and stream flow at the Cape.

No. 12. The acclimatization of freshwater game fish in the Cape Province and its relation to forest areas.

No. 13. The Knysna forests and the woodcutter problem.

No. 14. The exploitation of the indigenous forests of South Africa.

No. 15. An approach to the study of rainfall interception by forest canopies.

No. 16. The value of an immature plantation.

No. 17. Native names in use in Swaziland for trees shrubs and other plants.

No. 18. The establishment and maintenance of freshwater fish in South Africa. Part II.

No. 19. The relationship between modulus of rupture and weight in South African grown pine timber.

No. 20. The properties and uses of South African Kiaat (*Pterocarpus angolensis*) timber.

No. 21. A systematic basis for wood-uses research.

No. 22. Histological distribution of wattle bark tannin.

No. 23. The establishment and maintenance of freshwater fish in South Africa. Part I.

No. 24. Some West African substitutes for well-known timbers.

No. 25. Nomenclature of the South African yellowwoods.

No. 26. The variability of Jonkershoek streams.

No. 27. Progress of forest entomology in South Africa.

No. 28. The preservation of wood.

No. 29. Pulp and paper making as a South African industry.

No. 30. South African wattle bark and wattle extract with special reference to the American market.

No. 31. Tree-planting for commercial purposes.

No. 32. State afforestation after the war.

No. 33. A semi-evergreen form of Lombardy Poplar.

No. 34. A note on the vegetative propagation of *Pinus insignis*.

No. 35. A study in stem design.

No. 36. Modern methods of wood charcoal manufacture.

No. 37. Points on wattle production.

Bulletin No. 163. Utilization notes on the more common timbers of the Union of South Africa.

Bulletin No. 164. Common transvaal trees.

Bulletin No. 57. The silviculture of the indigenous forests of the Union of South Africa with special reference to the Forests of the Knysna region.

Bulletin No. 172. Report on drift sands in South Africa.

Bulletin No. 145. Weights of South African grown timbers.

#### PLANT MUSEUM HAS NEW USE

A plant introduction garden of the United States Department of Agriculture devoted to tropical plants has been serving lately for uses other than a preliminary location for potential food, feed, fiber and drug plants.

Specialists from the military services have used this garden as a botanical museum in which to teach men what trees, shrubs, and many other plants in tropical war areas look like. By means of living plant material obtained at the garden, these specialists are able to go out to show to others the actual specimens of the plants in a particular area which may be used for food, construction, camouflage, and other purposes.

## THE MISSOURI BOTANICAL GARDEN, 1860-1945

By HENRY N. ANDREWS, JR.

The Missouri Botanical Garden was founded nearly three quarters of a century ago as a permanent haven for plant lovers, scholars, and those who simply find joy in the peaceful quiet of a garden. Its facilities have always been at the disposal of everyone without thought of recompense to its founder, Henry Shaw. In spite of the official title it is known locally as Shaw's Garden, and it seems likely that the latter will always retain unofficial pre-eminence.

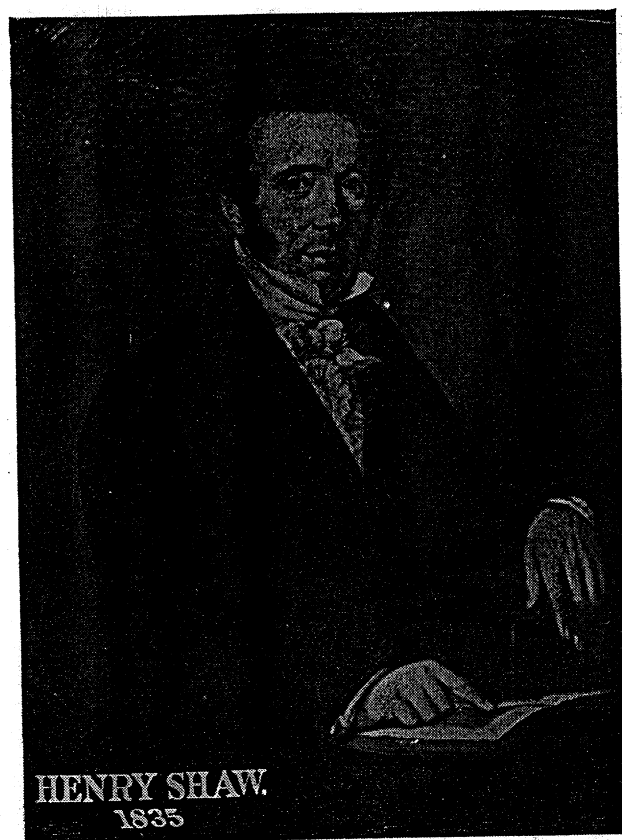
The birth of the Garden, in a slightly abstract sense came about in the year 1851 when Mr. Henry Shaw, a resident of St. Louis who had accumulated a very considerable fortune in this city, visited the magnificent grounds of Chatsworth in Devonshire. This and other of the great English and continental estates, imbued Mr. Shaw with a desire to create a creditable, although somewhat more modest, garden-estate in his adopted American city.

Henry Shaw was born in Sheffield, England, in 1800, and found his way to the rapidly expanding St. Louis in the spring of 1819. It was a city of river boats, of fur traders, and a last outfitting post for the innumerable caravans that soon flowed westward to explore and settle the plains and the mountains that lay beyond. It was a city ripe for young "captains of industry," and it soon was to need the foresight and generosity of men who could visualize the necessities of its future. As yet its citizens had given but little thought to permanent cultural institutions. It was into this pioneering, progressive scene, rich in opportunities that Henry Shaw stepped as a very young man. Starting with a small stock of Sheffield cutlery that he had brought with him, his enterprise expanded into a general merchandising business, so far beyond his fondest expectations, that by 1840 he felt that he had accumulated enough of worldly goods.

A considerable portion of the next few years Mr. Shaw spent in traveling through Europe and the Mediterranean region, and during this period the vision of a great botanic garden was formulated. When he returned from his last voyage in December, 1851, he immediately set about to crystallize the vision into reality.

In keeping with the traditions of wealthy English gentlemen, Henry Shaw had completed in 1849 a mansion on his country estate which he called "Tower Grove," while retaining at the same time his city residence on Seventh and Locust Streets. At that time nearly a century ago, when Jefferson Avenue marked the city limit it was quite a long carriage ride westward, midway between the Mississippi waterfront and the rolling hills bordering the Meramec River. As St. Louis has grown the estate now lies well within the bounds of the city and is readily accessible by bus and street car lines.

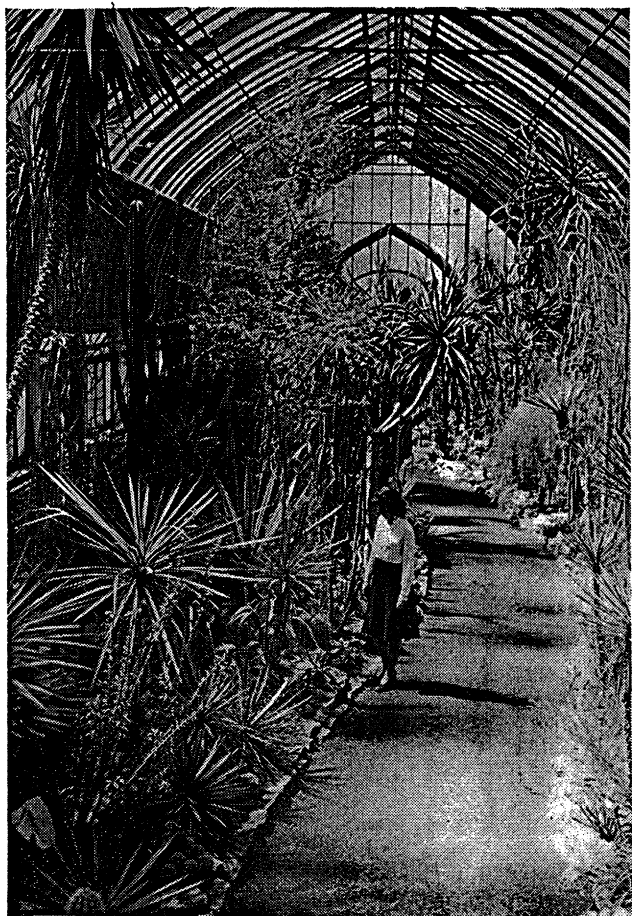
The woods and prairies that at first surrounded the mansion comprised a little over 100 acres although this was contracted in later years to its present size of 75 acres. Until his death in 1889 Mr. Shaw remained as the active and very able director of the improvements of this tract of land that was gradually fashioned into a botanical garden. For many of the more technical considerations of its development Mr. Shaw depended



upon Dr. George Engelmann of St. Louis and Dr. Asa Gray of Harvard University, the leading American botanists of their day. It was very largely through the efforts of these two men that Tower Grove was transformed into a botanical garden rather than just a fine country estate as apparently had been Mr. Shaw's original plan. Being professional botanists both Engelmann and Gray were able to visualize the vastly greater and more lasting benefits that a true botanical garden, with a library, herbarium, means of publication, and scientific as well as aesthetic treatment of living plants, would have for both botanical progress and the enjoyment of the people.

Thousands of trees, shrubs and smaller plants were set out, and greenhouses constructed to display exotics from tropical and sub-tropical climes. Of the buildings that were erected by Henry Shaw himself one greenhouse alone remains today—the Linnean House located north of the main public entrance; "Tower Grove" stands as a most impressive reminder of the early days, while a Museum building, now used for offices and lecture purposes, stands nearby. Facing Tower Grove Avenue to the east is Mr. Shaw's former city residence, which was moved to its present site within the Garden grounds in 1892. The latter, with a considerable addition, houses the library, herbarium and administrative offices.

The Library, devoted almost exclusively to botanical and horticultural works, has grown to be one of the finest of its kind in the country. Among the more valuable units included is the Sturtevant collection of pre-Linnean tomes, some of which date back as far as the late 14th century. As a record of botanical progress from Columbus' time up through the middle of the 18th century this collection of nearly 1,200 volumes is



Desert House-

equalled by very few libraries in the world. The present destruction of European libraries brings this collection even more to the fore, although by methods that we had not hoped for. Taken as a whole, the Garden Library contains about 56,000 volumes and 92,000 pamphlets. A considerable portion of the serial journals is obtained in exchange for our own publications—the quarterly “Annals,” a technical botanical journal, and the “Bulletin,” a monthly popular magazine devoted chiefly to the horticulture of this region.

The herbarium now totals very close to 1,500,000 plants gathered from almost all parts of the earth. The greater portion of these, classified and readily available for reference by staff members, students, and visiting botanists, are now filed in modern steel cabinets. Both library and herbarium have expanded to such an extent that additional space is imperative, and it is planned to erect a wing to the present building when relief from wartime restrictions renders it possible.

Under the administration of the present Director, Dr George T. Moore, vast improvements have been wrought in all branches of the Garden's activities. In 1913 the great greenhouse facing the main gate was completed. This included a central palm house, a northern wing devoted largely to cycads, and a southern wing housing succulents and plants of special economic interest. Chiefly through the travels and vigorous collecting activity of Mr. Ladislaus Cutak, the succulent collection has grown to the point where housing space is taxed to the limit. And during the last few years a special

effort has been made to transform the palm house into a rain-forest group. This has been at least partially accomplished through the introduction of appropriate ground cover plants, and the use of orchids and bromeliads as epiphytes. Thus the plants are blended into a more natural setting instead of being presented as an unorganized array of individuals.

Immediately to the west of this group lies the Italian garden, formal in contrast to the natural appearance of the other outdoor plantings. To the northwest of the cycad range lie the floral display houses, a tropical and curiosity house, and numerous others used for propagative purposes. All are open to the public except the growing houses.

The floral display house is the central point of interest to the average visitor at least during the winter months. In November the chrysanthemum show, coming at a time when practically all color has faded from the outside beds, attracts some of the largest crowds of the year. This gives place at Christmas time to the poinsettias and is followed in February by the orchid show, presenting an unrivaled display of the Garden's most valuable and renowned collection of living plants. In early spring the various shows feature cinerarias, azaleas, roses, schizanthus, hydrangeas and many other harbingers of warmer days. As the season progresses nature draws attention to the outside gardens. To the west and south of the old Linnean house a wide variety of spring perennials burst into bloom with the warmer days of April and May, followed by the roses a little later. Certainly the most colorful outdoor display is to be found in the Iris garden south of the old residence, “Tower Grove,” where more than 1,000 varieties of iris and a fine selection of peonies attract throngs of visitors during this season.

Among the Garden's outstanding horticultural achievements of the past few decades the large number of water-lily hybrids that have been created rank high. The pools centering the vista from the entrance gate to the palm house are devoted primarily to these plants. Through the work of Mr. George H. Pring, the Garden Superintendent, and his associates, many new color combinations have been achieved from plants originally introduced from Mexico, Africa, and other parts of the world.

The difficulties that beset the proper care of a large garden in the heart of a modern city are numerous and varied. The burden of taxation is no small obstacle but the man-made changes in atmospheric conditions are perhaps even more difficult to cope with. Up until a few years ago St. Louis held a foremost position among America's smoky cities, and many factories continue to pour into the atmosphere gases and chemicals that some plants are not able to combat. The evergreens, once a fine feature of the Garden, have almost all succumbed. Furthermore, the space within our present city confines does not allow the reproduction of large floristic habitats distinctive of Missouri. A part of the Garden does remain today in a more or less natural state but it is not sufficient to serve as a “museum” to display the many and distinctive plant societies found in the state.

Thus to allow expansion in a number of directions, impossible in the city, the Garden acquired in 1925 a 1600 acre tract of land about 35 miles west of the city, near the town of Gray Summit, on the northern fringe

of the rolling Ozark hills. A part of this tract is being developed into an Arboretum, a fine pinetum and flowering fruit orchards being already well established. Trails and roads are under construction, some of which were opened to the public a few years ago. In the early spring the fields adjoining the pinetum are gloriously colored with the blooms of thousands of *Narcissus* bulbs of many varieties.

The Meramec River flows through the wooded southern extremity of the tract and rising from its northern bank are massive limestone cliffs and glades, profusely colored during the spring months with dogwood, red-bud, delphinium, coreopsis, oenothera, and hundreds of other native species. Many acres of this tract, typifying some of the most characteristic natural Missouri floral displays, will be left in their original state. The Gray Summit tract also harbors 12 large greenhouses devoted primarily to the raising of orchids. This vast collection of approximately 20,000 plants, one of the largest in the world, has been growing rapidly since the early days of the garden. Greatly enhanced by the gift, in 1918, of the large and varied D. S. Brown collection. The Garden has sent Mr. Pring and other staff members on numerous expeditions to the American tropics in quest of new and interesting species. During the past few years the Garden's horticulturist, Dr. David C. Faurburn, has improved current methods of raising orchid plants from seed, employing chemiculture techniques, to an extent that may revolutionize this phase of American horticulture in coming years. As a result of these highly successful experiments a new range was constructed in the Gray Summit group last year which now accommodates 1,200 orchid plants growing in gravel and flushed daily with a chemical solution.

Like all similar institutions the Garden has been called upon to supply information and materials to various concerns encountering difficulty because of shortages incident to the war. Some eleven former students or members of the staff have been called upon to assist in the quinine and rubber development programs now in progress in Central and South America. Requests from chemical firms, physicians, airplane and other manufacturers, as well as the government have been answered through the facilities afforded by the library, herbarium, and staff members. Such practical problems, as the development of a variety of castor bean that can be handled with a combine, the use of cattle in developing a blue grass meadow, the selection of grasses especially adapted to the St. Louis region, the growing of leaves of *Aloe vera* for the treatment of x-ray and radium burns, locating a source of supply for rare plants needed for specific purposes, have been solved in most cases satisfactorily, and it is believed in a way that could only have been achieved by an institution like the Botanical Garden.

The horticultural efforts of an institution such as this are more or less evident. The gardens and their contained plants are readily appreciated. But the scenes that lie behind this stage are not often well known or understood. It became evident to Mr. Shaw in the later years of his life that if the Garden were to serve to the fullest degree of its capacity, botanical science as well as horticulture, a sound educational program must be formulated.

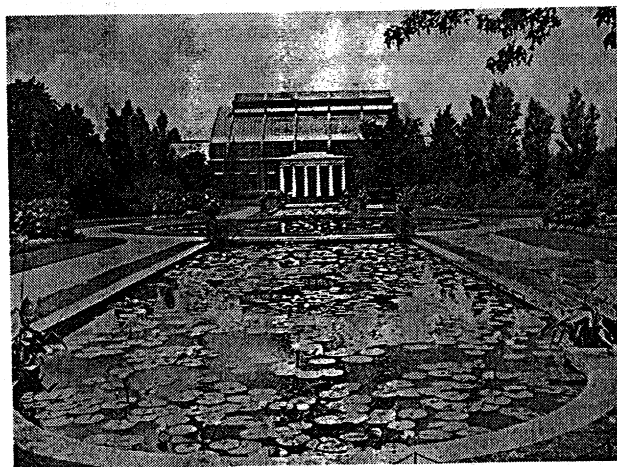
Thus in 1885, about 25 years after the garden was opened to the public, Mr. Shaw conceived a plan where-



Economic Garden.



Italian Garden.



Main greenhouse and tropical pools,  
Missouri Botanical Garden

by a School of Botany might be created in conjunction with Washington University. In order to maintain this newly established Henry Shaw School of Botany Mr. Shaw deeded to the University a piece of property the income from which was to support the School, with the provision that if the income from said property dropped below a stipulated minimum the balance should be made up by the Trustees of the Garden. It may be pertinent to note, however, that the Missouri Botanical Garden and Washington University have always operated under distinct administrations. Each is controlled by its own Board of Directors or Trustees and supported by its own private endowments, there being no legal obligations between the two other than the one mentioned.

The botanical staff has increased until it now includes seven full-time members, and a varying number of assistants. A wide variety of undergraduate and graduate courses are offered, although the School is better known for its graduate division. Since its inauguration in 1885 it has drawn graduate students from more than 26 states and a number of foreign countries. To date 69 Ph. D. degrees have been awarded, the holders of which occupy many important positions in colleges, universities, museums, various branches of the United States Department of Agriculture, as well as in private industry.

A brief resume of the research programs that certain staff members are prosecuting may serve to illustrate this phase of the Garden's contributions to American science. For some few years now Dr. Robert E. Woodson and Dr. W. Schery have been engaged in a detailed study of the flora of Panama, a region of very important American interests, and until recently the Garden maintained a station in the Canal Zone that served as a base for collecting expeditions and as a source of tropical plants. In 1938 Dr. Carrol W. Dodge, the Garden's mycologist, published in collaboration with Dr. Gladys E. Baker, a monumental work on the Antarctic lichens collected by the Second Byrd Expedition. Dr. Dodge is now at work on plants collected by the Third Expedition, and spent the year 1941-42 as a Guggenheim Fellow continuing his researches in lichenology and medical mycology in Guatemala. Dr. Edgar Anderson, Geneticist to the Garden, has been engaged for the past few years in a study of the origin and development of Indian corn. His extensive field investigations have carried him through the southwest and various parts of Mexico in search of the early ancestors of the maize grown in the United States today. For the past five years Dr. H. N. Andrews and his students have been investigating the fossil flora of the southern Illinois coal fields and of certain deposits through the western states. A considerable array of previously unknown plants have been revived from their long entombment in the rocks, contributing to our knowledge of the plant life that existed on the earth ages ago.

As a source of general horticultural information the Garden is well known and frequently consulted by gardeners not only in the St. Louis region, but throughout the United States. It is also visited each year by thousands of school children who are conducted through the grounds by an instructor appointed especially for that purpose by the City Board of Education.

The Garden has always attempted to meet in so far as possible the current horticultural needs of the peo-

ple. Since its earliest days class work, as well as an abundance of practical training, has been given to young men and women serving as apprentice gardeners. For many years a general introductory course in horticulture has been given during the winter months and applications for enrollment always exceed the limits of available facilities.

During the past two years demonstration vegetable gardens have been maintained as an aid to the many people who have taken to raising a significant portion of their own food supply. In September of last year this culminated in a most successful Harvest Show sponsored by the Garden and in which more than three hundred local gardeners participated. It is our hope that many of these novitiates who have found profit, pride, and joy in growing vegetables will continue to do so. The Garden is glad to have had a part in this, as in many other phases of plant lore, and may the future find it ready as in the past to meet the changing demands of botanical science.

## Publications of Chemurgic Interest

**PERMANENT MAGNETIC SEPARATORS FOR REMOVING TRAMP IRON FROM GRAINS AND FOODS.** Published by Eriez Manufacturing Company, Erie, Pennsylvania, and available without charge. A four-page bulletin prepared to show how permanent magnetic separators can be installed in chutes and feed tables. Shows new Alnico steel magnets which eliminate any need of wiring to produce power to remove tramp metal from materials. Tells how to remove tramp metal from feed eliminating source of possible death to cattle, mill fires and damage to grinding machinery.

## RESEARCH—PUBLIC AND INDUSTRIAL

Arthur W. Turner, in charge of agricultural engineering research, United States Department of Agriculture, recently stated:

"Federal and State experiment station research can be in no sense regarded as a substitute for, nor competitive with, research done in the industrial research laboratories. The latter is essential if the new developments in fundamental science are to be translated into industrial processes and products. Federal research must be regarded, along with the state college research, as the principal source of that body of fundamental science which the industrial research laboratory will bring into practical application."

## CHEMURGY IN INDIANA

Chemurgy marches on in Indiana as Governor Ralph F. Gates signed a bill last week enacted by the General Assembly of the State for the establishment of a division at Purdue University for hemuregic research.

This recently created division will devote its efforts to new industrial uses for Indiana agricultural products and wastes.

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*A clean white fiber can be obtained from the stringy-bark tree of Australia, reports a foreign publication. This was previously reported as a possible substitute cordage fiber, but later was rejected because it does not possess sufficient strength.*

# GROWING AND HARVESTING PINE TIMBER

By CHARLES H. SPROTT, Forester  
Southland Paper Mills, Inc.  
Lufkin, Texas

## Introduction

Inasmuch as our forests are our only renewable natural resource, it is only sound economy to keep them in growing condition and fully stocked. The demands of war have drawn heavily on our forest reserves and at present we are annually cutting more timber than we are growing. The forests in Texas, although occupying less than a fifth of the total land area, represent one of our major natural resources. This forest area to which I will primarily confine these remarks is located in the most eastern portion of this state and offers our forest industries marked advantages over many other sections of the county as climate and soil favor rapid tree growth.

The assurance of the establishment of a new stand of timber on forest land is of vital importance if we are to produce the wood needed for our many wood using industries. Figures put out by the United States Forest Service indicate that east Texas forests are in general, understocked and producing at less than half of their potential capacity. This condition exists primarily because of fires, ruthless logging practices of the past and, I regret to say of some present day operators. It should be pointed out, though, that of the 153 millions acres of private timber lands in the United States, approximately 46 percent of it is under some form of forest management today.

The Southern Yellow Pines, namely Short leaf (*Pinus echinatus*), long leaf pine (*Pinus palustris*) and loblolly pine (*Pinus taeda*) of east Texas will quickly reseed a cut over area if sufficient seed trees remain after the cutting. Long leaf pine is the slowest to reseed, as the amount of seed produced annually is usually small with only from 10 to 20 percent germination unless specially treated. Unlike the other Southern pines, long leaf makes very little growth in height until the third or even the fifth year and is often crowded out by weeds and brush.

In some cases, cut over long leaf areas reseed in loblolly or are planted in Slash pine (*Pinus caribaea*), which is not a native pine west of the Mississippi River, but has proven satisfactory in plantations.

By far the worst enemy we have in growing timber is fire which burned over an average of 183,078 acres or 286 square miles annually for the five year period from 1939 through 1943 on 8,852,047 acres comprising the net acreage within the Texas Forest Service protection units in east Texas. There are some 4 or 5 million gross acres within the East Texas timber belt which are not in the protection units and it is reasonable to assume the percentage of burned area is larger there, although there are no definite figures on this area.

There is no way to determine the exact number of small pine seedlings, which ordinarily go unnoticed, but are the forests of tomorrow, that are killed annually by fires. These fires not only destroy the young seedlings and some merchantable timber, but it retards the growth of the remaining stand. From the January, 1942, *Southern Forestry Notes* issued by the Southern Forest Experiment Station, I will quote a section of an article by E. L. Stone:

"The results show that in trees under 6 inches D.B.H. radial growth during the first year after a fire ranged from 0 to 65 percent, averaging 23 percent, less than the growth without fire. Larger trees with higher crowns were less affected, but decreases up to 35 percent, averaging 19 percent, were found. Presumably this variation in effect is due chiefly to variable fire intensity which results in various degrees of defoliation."

The method of harvesting a tract of timber is in part responsible for the establishment of a new stand and in increasing the growth of the residual stand. I will outline briefly these methods and their effect on the growth of our forest.

There are primarily three general methods of cutting timber which are used in this section, namely, clear cutting, seed tree cutting and selective cutting.

## Clear Cutting

This method of cutting is used much too often in harvesting our timber crops, both for saw logs and pulpwood.

By clear cutting I mean removing all the merchantable timber in one cutting operation. This method leaves the land open for soil and wind erosion and allows less desirable species to take over the site, crowding out most of the pine seedlings which might attempt to reseed. To secure another stand of timber on such an area within a reasonable length of time it should be planted with nursery grown stock.

The paper mills have been severely criticized for using this method of cutting, but all of the criticism should not be placed on the mills, as the timber owners usually state the way they wish their timber out, although I am aware of the fact there is improvement to be made on the mills' part, the same as on the land owners' part.

## Seed Tree Cutting

"A seed tree is a healthy, well formed tree at least 10 to 12 inches in diameter, left to reforest an area from which the timber has been cut."

This is the definition of a seed tree given by the Southern Pulpwood Conservation Association. There should be at least 6 or 8 such seed trees left per acre to assure sufficient seed in reseeding the area.

Provided fire is kept out these trees should quickly reseed an area. After a new stand has been established the seed trees can be removed as quality logs or poles and will have served a dual purpose.

This type of cutting is superior to clear cutting, but is not as advantageous as selective cutting. If undesirable species are already established opening up the stand to this extent will stimulate their growth, and the more desirable pine species may be crowded out and the period of reforestation lengthened. There is a much longer cutting cycle required and full advantage is not taken of the increase in growth by releasing the residual stand, as when the selective cutting method is used.

## Selective Cutting

In growing timber at a financial profit and in filling the wood demands that are becoming more and more

acute, we have to look toward some form of forest management which will assure a continuous production.

Sustained-yield management seems to fulfill this demand as its aim is to build up the volume and quality of the merchantable timber. The volume can be increased by currently removing less volume than is added by growth, and the quality can be improved by removing trees of poor form and vigor. This is brought about by selectively cutting our forests instead of removing the better trees, leaving the poorer ones and failing to regulate density by thinning overstocked stands and filling blank spaces in understocked stands.

#### Harvesting Pine Pulpwood

During last winter's ice storm, over part of the east Texas Timber belt the paper mills in this area were in a position to render assistance by salvaging the damaged pine timber which was largely unfit for other wood products such as logs, poles and piling.

The method of harvesting pulpwood lent itself to these distorted forests. At present our pulpwood operations still depend largely in east Texas on the cross cut and one man pulpsaw for producing the wood. There are several different types of power saws which have been introduced into this section, but as yet they are not extensively used. There are probably nearly as many variations in actually handling the logging operations as there are producers, but I will give here the general method used in harvesting the wood in this area.

The trees to be cut are marked before the saw crews start cutting a tract of timber with two spots of point, if it is to be cut selectively, one spot about head high on the trunk of the tree and one at the base of the tree. The marking is done by someone who knows the approximate value and volume of the trees he is marking and the ones he is leaving to grow. The spot on the trunk of the tree is to indicate to the cutters that the tree is to be taken. The mark at the base of the tree is used to check behind the saw crews and see that they do not cut trees that were intended to be left.

The trees are felled and usually limbed, topped and bucked up in the woods into 4 or 5 foot lengths, depending on the mill specifications. Some operators skid the tree lengths after they have been limbed and topped to a central point where they are cut into the shorter sizes or in some cases they are hauled to the mill before they are cut. When the bolts are cut in the woods they are usually penned in five foot pens. This is done to keep the wood from rotting on the ground when it is not hauled immediately.

The wood is usually hauled from the woods by trucks equipped with a bed suitable for stacking on this length wood and is taken either directly to the mill or to the railroad siding to be shipped to the mill where it is converted into the various kinds of pulp and papers.

\* \* \*

*C. E. Wilson, president of General Motors Corporation, recently made the following statement on the important part that paper will play in the postwar world. "No physical activity goes on in this complicated age, no plants are built, no machinery installed, no piece of inanimate material moves from one place to another, without a piece of paper to direct it. Each part has to be named or numbered and a piece of paper must go along with it to tell somebody what to do with it and where it is to go."—Mead Paper News.*

## GUARANA

Guaraná is a creeper of the family of the Sapindaceas, discovered for the first time by Humboldt and Bompland on the Orinoco, and in 1821 described by Kunt, who called it "Paulinia Cupana." Martin encountered it in 1826 in the Amazon Valley, and called it "Paulinia Sorbilis." It flowers in July and is picked from October to December. Its fruit, more or less the size of a hazel nut, contains a round brown seed with a seminal coating, white and farinaceous.

The industrial exploitation of guaraná is rudimentary; the ripe bunches are picked and soaked in water, allowing the seed vessel to open. The seeds are then roasted and skinned, and the result is a homogeneous, plastic mass, from which cylindrical cakes are prepared, weighing about 250 grams. These cakes are then smoked to insure better preservation.

The fluid extract of guaraná is used widely in the manufacture of sweets, sirups, and one of the most popular and refreshing drinks in Brazil.

By its chemical composition, the principal action of guaraná is "neuro myocardiatic" and "diuretic," the former rapid and powerful, the latter gentle and regular. Here we have a real nutritive aid, stomachic and invigorating; and a drink that is both agreeable and refreshing. The artificial stimulation of alcoholic beverages is temporary and followed by nervous depression, while guaraná renews organic losses, imparts new vigor to the tired system, and gives relief to overworked brains. No stomach refuses it, no palate will deny its "fluid extract." Although rich in caffeine, it does not induce insomnia or nervous irritation and can be taken in large doses without the slightest discomfort. Guaraná has a soothing effect, prevents arteriosclerosis and is said to possess life-prolonging properties. It is recommended in the treatment of disorders of the digestive organs as remedy for paludism and dysmenorrhea and is being used extensively in modern chemistry.

The areas where guaraná is found are in the Amazon region, but due to the fact that cultivation is limited to approximately 50,000 acres, production is small.

It is said guaraná is of great commercial value because analysis shows it to contain in every 100 grams the following:

caffeine .....	5.388
fixed yellow oil .....	2.950
red resin .....	7.800
red coloring element .....	1.520
amorphous element .....	0.050
saponine .....	0.060
guaraná acid—tannic .....	5.902
pyrous acid—guaraná .....	2.750
starch .....	9.350
glycose .....	0.777
pectin, dextrine, salts, etc. ....	7.470
vegetable fiber .....	49.125
water .....	7.650

\* \* \*

*Rubber tires, gasoline tanks, hot-water bottles and similar articles are made proof against leakage of either air or liquids by a double-walled, plastic-bonded construction. The plastic between the two bonding layers of vulcanized rubber automatically seals incipient leaks and small punctures and prevents their becoming more serious.—Mead Paper News.*

# HODO, A NEW SORGHUM SYRUP DESCRIBED

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Hodo sorghum grown for sirup production at U. S. Sugar Plant Field Station, Meridian, during 1943.  
Seed head of Hodo at right.

Hodo, a variety of sorghum which has been grown locally in Mississippi for a number of years, has shown definite value in variety tests and is being recommended for sorgo-sirup production.

**History.** The origin of this variety cannot be definitely determined. Apparently, the earliest mention of it in a publication was by the late W. R. Perkins, formerly director of the Mississippi Agricultural Experiment Station. In Volume 2, Number 4 of *Mississippi Farm Research*, published in April, 1939, he reported that a sorgo called Hodo had been grown by North Mississippi farmers for an unknown period of time. He considered it at that time a heavy yielding variety that matures late. Seed of this variety have been disturbed among farmers so that it now is grown and known by the name Hodo throughout the sorgo-growing area of the State.

**Description.** Plants of this variety are late, being a slow grower and influenced considerably by season. Stalks grow very tall, reaching a height of 15 feet when grown on good land under favorable growing conditions. The stems are stout, tapering toward the top. They are juicy and sweet, producing large yields of sirup of good quality.

The variety of Hodo branches (suckers) seldom to mid-freely. It is leafy, that is, the broad long leaves comprise a high percent of the total weight of the plant, as compared to other common varieties.

The panicle (seed head) is erect, mid-compact, and ellipsoid in form. The glumes which almost cover the seed, are very dark red, appearing almost black on casual inspection of a field. The seed are light brown in color. A typical panicle of Hodo and a plot of this variety are shown in the illustrations.

Appreciation is expressed to I. E. Stokes, Associate Agronomist, Sugar Plants Field Station, Meridian, Mississippi, for assistance in preparation of the description and making the photographs.—(This material was provided through the courtesy of the author and the director of the Mississippi Agricultural Experiment Station, Dr. Clarence Dorman.)

*American paper mills manufacture far more than one-half the world's production; capacity more than 18,000,000 tons; employees about 500,000 per capita consumption in the United States about 300 pounds; variety of paper products estimated at more than 14,000.—Paper Digest, National Research Bureau.*

## Of Chemurgic Interest

Two hundred tons of apples from the Kelowna, British Columbia, crop this year are in storage in Okanagan Lake. The Canadian National Railways granted permission to the B. C. Tree Fruits, Ltd., to use its pier at Okanagan Lake for the experiment in an effort to save apples which otherwise would rapidly deteriorate in consequence of the shortage of storage space. Herring net, 600 feet of it, was attached to the pier piles and then weighted with lead. The net sinks down into the water to a depth of ten feet and covers the area under the pier. Culls, or low-grade apples, are being used for dehydration and other byproducts and if the experiment is unsuccessful the loss will be negligible.

The first penicillin factory in the Soviet Union has recently been established in Moscow, reports the foreign press.

DDT, the most potent weapon against insects ever discovered, is living up to military expectations, according to J. A. Jenemann of the du Pont Company in a recent address to the National Association of Insecticide and Disinfectant Manufacturers. "But," he warned, "much testing must be done before we can offer it to the public. We must be able to decide in what form DDT should be compounded for the householder, what it is good for, how it should be used and what, if any, precautions should be taken."

NEOPRENE is the only synthetic rubber that does not support combustion. Accordingly, it is used as flame-resisting jackets for electric wires and cable on shipboard.

A factory for the production of porous wallboard is to be established at Svaneskog, Sweden, according to a foreign trade journal, but will not start operating until some time in the spring of 1945. It is said that the annual capacity of the plant will be about 10,000 tons of porous boards.

"In the United States we have more than 70,000 researchers in 3,400 industrial laboratories," says Dr. Cole Coolidge, assistant chemical director of the du Pont Company, "and there is reason to believe that research will create millions of jobs in the future as it has in the past. Fifteen of our major manufacturing industries have been developed since 1870, creating an estimated 15 million jobs. On the basis of these figures, about one out of every four persons gainfully employed today owes his job in whole or in part to developments based on scientific research."

Each serviceman in the Pacific requires 16 tons of shipping for the first 30 days and about 6 tons each month thereafter, says the Navy. Atmospheric and other conditions in that area require more careful wrapping to protect from humidity, rot, vermin and other pests. The paper shortage will be far from over after victory in Europe.

\* \* \*

*A civilization which embellishes and supports the pattern of nature or the natural order will endure while any civilization which attempts to emancipate man from the controlling influences of the entity of which he is a part is preordained to fail.*—John Leahy, Cotton Research Committee of Texas.

## NEW SYNTHETIC FIBER REPORTED

A new fiber, called Ardill, has been developed in the United Kingdom. It is made from peanuts and is described as cream-colored, crimped, resilient, and soft and warm to the touch. It is moisture absorbent, and has dyeing qualities similar to those of wool. It is said not to shrink, and not to be attractive to moths.

After the oil has been extracted, the protein is extracted with dilute alkali, precipitated and made into a spinning solution. The spinning solution is extruded through a spinneret into a coagulating bath. The fine filaments so obtained can be cut into whatever lengths are required for their final use.

About 500 pounds of fiber reportedly can be obtained from 1 ton of nuts.

Ardil fiber probably will be used as a complementary fiber, mixed with wool, cotton, or rayon.—*Foreign Commerce Weekly*.

## CHEMURGY IN TEXAS

The Texas Chemurgic Council is making plans to launch a far-reaching research program to assure the increased industrial utilization of the State of Texas' vast variety of raw materials of farm and forest, cotton, wool, clays, minerals and pasture grasses.

The executive committee of the state chemurgic council recently held a meeting in Dallas, Texas, to prepare a program for the legislature. Victor H. Schoffelmayer, member of the Board of Governors of the National Farm Chemurgic Council, and chairman of the Texas council, presided at this meeting, outlining the general projects for the activities of the newly organized group. Their objective is closer cooperation between agriculture, industry, and science, through applied research.

The Texas legislature will be provided with definite information concerning special needs of agriculture, forestry, minerals, and animal fibers upon which new industries may be based or may expand to meet post-war needs for jobs and material.

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